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Joint Service Common Operating Environment (COE) Common Geographic Information System Functional Requirements

W. D. Meitzler

June 1992

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JOINT SERVICE COMMON OPERATING ENVIRONMENT (COE) COMMON GEOGRAPHIC INFORMATION SYSTEM FUNCTIONAL REQUIREMENTS

Prepared for:

COE WORKING GROUP

Prepared by:

Wayne D. Meitzler
Pacific Northwest Laboratory

COE Mapping Requirements Working Group

June 1992

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PREFACE

The Joint Service Common Operating Environment (COE) is an organization comprised of representatives from each of the United States military services and supporting organization. Its purpose is to facilitate the standardization of software and information exchange across the services. The COE established an action item to address the electronic mapping, now referred to as the Common Geographic Information System (CCGIS) Functional Requirements, which resulted in the formation of the COE Mapping Requirements Working Group. This document presents the CCGIS requirements identified by the group as of January 1, 1992. Participants in the Mapping Requirements Working Group include the following:

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SECTION 1

1.0 SCOPE

1.1 IDENTIFICATION. This document establishes the functional requirements for the Joint Service Common Operating Environment (COE) Common Geographic Information System (CGIS) subsequently designated as CCGIS.

1.2 SYSTEM OVERVIEW. The COE concept provides for an aggregate set of computer-based tools and standards to support the means by which the joint United States Armed Forces can employ and sustain tactical forces in the theater of operations. All military service command and control echelons are expected to benefit from the capabilities that the COE concept provides through the interoperability of each service's C4I Tactical Decision Systems (TDS). The goal of COE is to provide a common software/hardware reference and interface standard to support the many combat systems allowing each to retain control of their computing resources and application, yet offering the integration of common information and low level software components to achieve interoperability. Through this integration, the resulting system is to realize a level of interoperability among the C4I systems and cost savings through the use of common threads. One such common thread is the Geographic Information System (GIS) whose map display and analysis functionality are common to many of the original combat systems. The purpose of this document is to present the Functional Requirements for the Common Geographic Information System (CGIS) element which will ultimately be integral to the COE suite of proposed standards and C4I systems and designated as CCGIS. One should note that participation in COE is voluntary and includes organizations within each military service.

1.3 DOCUMENT OVERVIEW. This CCGIS Functional Requirements Document describes the common geographic information system capabilities and functionality necessary for the COE CCGIS mission. The COE concept to which CCGIS is an integral subcomponent, and other system interfaces are only presented to show the context of CCGIS in terms of the big picture. The functional requirements are based on input from the COE participants. This document will change with time as the requirements change through a configuration management process. As part of the overall COE, the subsequent military systems claiming COE compliance shall be based on the requirements presented herein.

At this time, the CCGIS is in the requirements stage. The reader of this document needs to focus on the common GIS requirements. Great care should be given not to draw early design or standards conclusions.

SECTION 2

2.0 APPLICABLE DOCUMENTS

The following documents are referenced to provide background information specific to the CCGIS. When referenced specifically in other sections of this document, the referenced material becomes part of the requirement specification.

2.1 GOVERNMENT DOCUMENTS

The following documents of the exact issue shown, form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this document shall be considered a superseding requirement.

2.1.1 SPECIFICATIONS, STANDARDS, AND HANDBOOKS

DOD-STD-2167A	Defense System Software Development
MIL-STD-490A	Specification Practices
FM 101-5-1	Operational Terms and Symbols Department of the Army, US Army
FM 21-26	Field Manual FM 21-26 Map Reading, US Army
FM 21-30	Military Symbols FM21-30, US Army
FM 34-2	Intelligence Analysis
	Draft US Army Tactical C3I System of Systems Common ATCCS Support Software (CASS) System/Segment Specification (SSS), 15 March 1991, US Army
AR 380-380	US Army
STP 5-81Q1	Soldier's Manuals for Terrain Analysts, US Army
TM 8358.1	DMA Technical Manual 8358.1 - Datums, Ellipsoids, and Grid Reference Systems, Defense Mapping Agency
TM 8358.2	DMA Technical Manual 8358.2

Digitizing the Future, Defense Mapping Agency

Tactical Terrain Data (TTD), Defense Mapping Agency

MILITARY HANDBOOK-850, (Draft) DoD Glossary of Mapping, Charting, & Geodetic Terms, March 1991

MILITARY STANDARD 600006, Vector Product Format (VPF) Draft, DMA MC&G Technology Area, Defense Standardization Program

Defense Intelligence Agency National Imagery Transmission Format Standards (NITFS), Draft DoD Imagery and Message Standard

Standard For The Exchange of Digital Information On CD-ROM, CD-ROM Read Only Data Exchange Standard (CD-RDx), (Draft) May 1991

2.1.2 **OTHER GOVERNMENT DOCUMENTS, DRAWINGS, AND PUBLICATIONS**

Marine Corps Command and Control Master Plan, 3 Aug 1987, Marine Corps

Marine Tactical Command and Control System (MTACCS) Master Acquisition Plan (MAP), 26 Dec 90, Marine Corps

MAGTF Interoperability Requirements (MIRC), MCCDC, 4 May 90 w/changes

DMA Mapping Applications Study, Aug 1989, Defense Mapping Agency for the Marine Corps Research, Development, and Acquisition Command (C2AS)

MTACCS, Marine Corps Research, Development, and Acquisition Command, Quantico, Virginia

A Process for Evaluating Geographic Information Systems, Federal Interagency Coordinating Committee of Digital Cartography

DMA Technical Report 8350.2, "Department of Defense World Geodetic System 1984: Its Definition and Relationships With Local Geodetic Systems", 2nd Edition, September 1, 1991

DoD Directive 4630.5, (to be dated in 1992) "Compatibility and Interoperability of Tactical Command, Control, Communications, and Intelligence Systems"

DMA Digital Products Study: Uses, Specifications and Standards, Executive Summary May 3 1991, and Volumes I-III October 26 1991

Introduction to Geographic Information Systems, Defense Mapping School Paper, undated

Defense Mapping School DMS No. St 051, "Geographic Information Systems, An Overview", January 1989

2.2 NON-GOVERNMENT DOCUMENTS

The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

GE Aerospace. December 1990. Common ATCCS Support Software (CASS) Architecture Description and Operational Concept

Pacific Northwest Laboratory. April 1991. Draft Hardware/Software Architecture Recommendations for NTACCS

GE Aerospace, System Integration Programs Department. June 1990. Common ATCCS Support Software System/Segment Specification, Draft 4. Philadelphia, Pennsylvania

AMSAA, SEEFAR: An Improved Model for Producing Line-of-Sight Maps, Tech Report No 225, author Barbara D. Broome, Sept 1980

R. Lanigan, SEEFAR-A terrain masking Model for the VAX 11/780, Boeing Document No. BCS 40404, January 1984

Technical society and technical association specifications and standards are generally available for reference. They are also distributed among technical groups and federal agencies.

Copies of specifications, standards, drawings, and publications required by suppliers in connection with specified procurement functions should be obtained from the contracting agency or as directed by the contracting officer.

SECTION 3

3.0 SYSTEM REQUIREMENTS

3.1 DEFINITION

3.1.1 CCGIS. In the context of this document and COE, the Geographic Information Systems (GIS) are decision support systems involving the integration of spatially referenced data in a problem solving environment. They are digital computer systems for capturing, processing, managing, displaying, modeling, and analyzing geographically referenced spatial data which are described by attribute data and location. The ability to perform spatial analysis and the ability to combine two or more data sets to create new spatial information differentiates a GIS from other computer mapping systems. While the CCGIS allows for data editing and input, its primary purpose is not to prepare data, but rather to manipulate, analyze, and clarify it. The CCGIS defined herein provides GIS services and resources including the spatial and map related functionality common to all subsystems contained within the COE suite of C4I systems. The CCGIS, which is an integral component of the COE concept, relies on the other COE standard components to provide the definition for other support computing services required. For example, it shall use operating system and user interface services based on the other established COE standards. The CCGIS also relies on computer hardware standards established by the COE. CCGIS can be presented in terms of organizational layers. Figure 1 presents the basic organization of the CCGIS in the context of COE. The system layer architecture is consistent with the Marine MTACCS and Army ATCCS hardware/software model. These models are believed to be consistent with the SIMS model. The CCGIS is expected to adhere to the COTS and GOTS component concept. Thus, CCGIS provides the spatial and map-related tool framework within the COE to which it is an integral component.

3.1.1.1 CCGIS Application Layer Software. The CCGIS shall include an application layer of software which interfaces directly with the user in conformance with the COE Style Guide and which accompanies and complements the other critical joint service C4I applications. CCGIS application functionality required includes generic spatial and map information display and edit, data management, selected Tactical Decision Aids (TDAs), and database control services. The COE application level software shall interface directly with the COE support software (Layer 3) which also includes other COE software components.

3.1.1.2 **CCGIS Library Software (MCBSS Layer).** The CCGIS software shall include COE support level software which provides the lower level GIS software services that the specific military service C4Is and applications will draw on to perform spatial and map related functions. Like other application software, this software shall utilize COE support layer software components (Layers 2 & 3) to perform non-GIS computations.

3.1.1.3 **SPATIAL DBMS (SPDMS).** The Spatial Database Management System (SPDMS) shall provide the fundamental software engine which physically manipulates, orchestrates, accesses, and manages the spatial data. The SPDMS, a Layer 2 component, shall provide the basic services required by the Layer 3 library software and the other command & control support software all of which support Layer 4 applications.

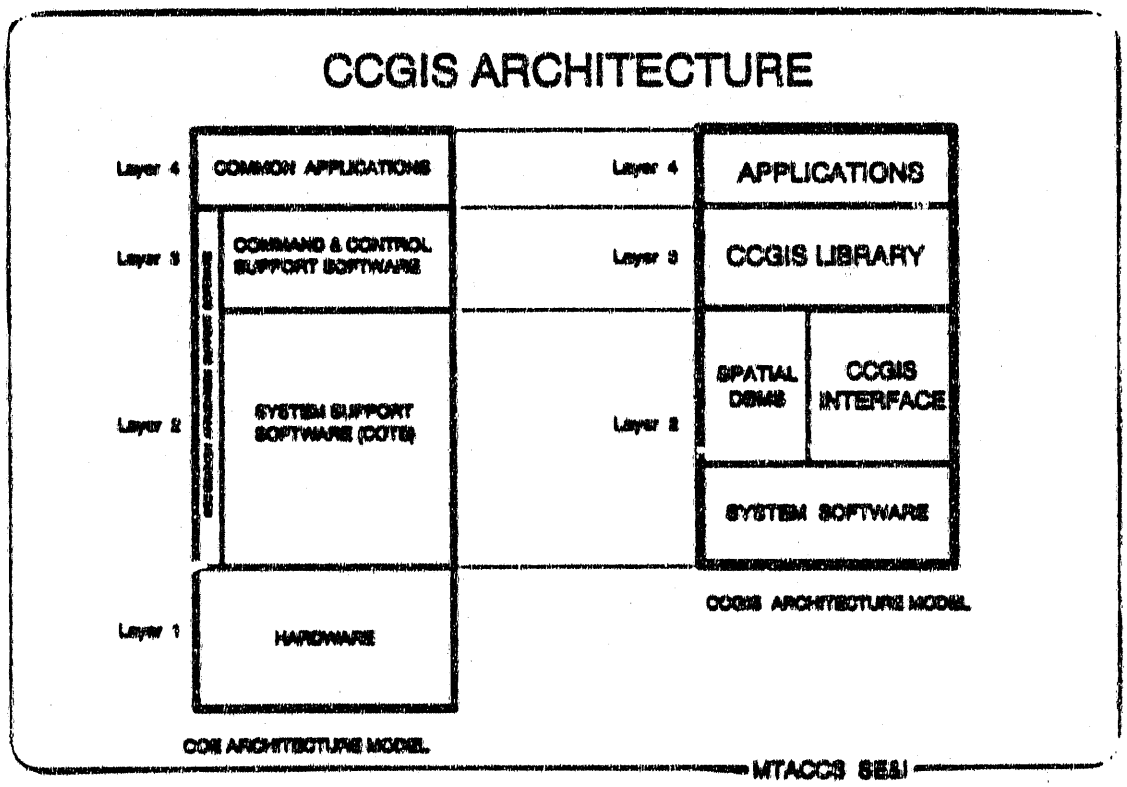

FIGURE 1. Basic CCGIS Organization

3.1.1.4 **CCGIS Interface.** If the spatial DBMS implementations differ among service C4I systems, the CCGIS interface shall provide all services necessary for either system to access, manipulate, and display the other systems data, assuming authorization for data access is in place. The CCGIS, via the CCGIS interface, shall allow C4I systems to be interoperable with regard to common GIS functions.

3.1.2 **Applications.** Perhaps one of the most important CCGIS components is the application. The application is the highest level software tailored specifically for a C4I combat system or one of its tactical decision aids (TDAs). Control of the applications, as well as the computer hardware for a combat system, is the responsibility of the C4I system program manager. Applications use the CCGIS as building blocks on which to construct their TDA software. Groupings of TDAs based on a common mission result in C4I systems. In the context of the CCGIS, applications are computer programs which use the CCGIS building blocks like other support software building blocks in order to accomplish their ultimate functionality.

3.1.3 **Users.** The users of CCGIS are categorized in three major groups. The groups are summarized below along with other names frequently used to describe them. The first two groups are actual military personnel used in support of tactical operations. A more detailed description of each user group follows the list of CCGIS users.

- **User** - Military personnel, end user, operator, staff officer, non-commissioned officer
- **Database/System Manager** - Computer specialist, database administrator
- **Software Developer** - Application programmer, tactical decision aid (TDA) developer, decision support programmer, contractor

The CCGIS "User" is the person who operates the system on a day-to-day basis and in combat situations. Usually, the user is the original operator of the C4I combat system. There shall be no requirements for CCGIS-only operators. The user represents the majority of the people involved with the operation of the system once it is fielded.

Despite the advances in computer technology, there never seems to be enough storage capacity to retain all information of interest. The "Database/System Manager" tailors system databases when such requirements are beyond the means of the semi-automated data management facilities contained within the system. The database/system manager also is the primary person who establishes user accounts, implements security controls, configures databases, and enters large volumes of new data.

The "Software Developer" writes computer programs to tailor the system to specific functions or applications (e.g., TDAs) for C4I operations. They basically develop computer software based on the CCGIS compliant components. The resulting software becomes an integral part of the C4I systems. Their primary involvement is prior to fielding a C4I system. Software developers are frequently contractors supporting a military service organization.

C4I systems incorporating the CCGIS are expected to have these groups of users. Other support service personnel, such as hardware maintenance technicians, are not identified here because they are already part of a C4I system and would need to perform their services regardless of the CCGIS.

3.1.4 **Bindings.** In order to support a truly modular software concept and to allow for software module exchanges, bindings need to be established to interface intentionally dissimilar components. The bindings become the vehicle by which the dissimilar entities can function. Three binding types shall be established for the CCGIS. The relationships of these bindings are shown in Figure 2, CCGIS Concept. A brief description of each binding follows.

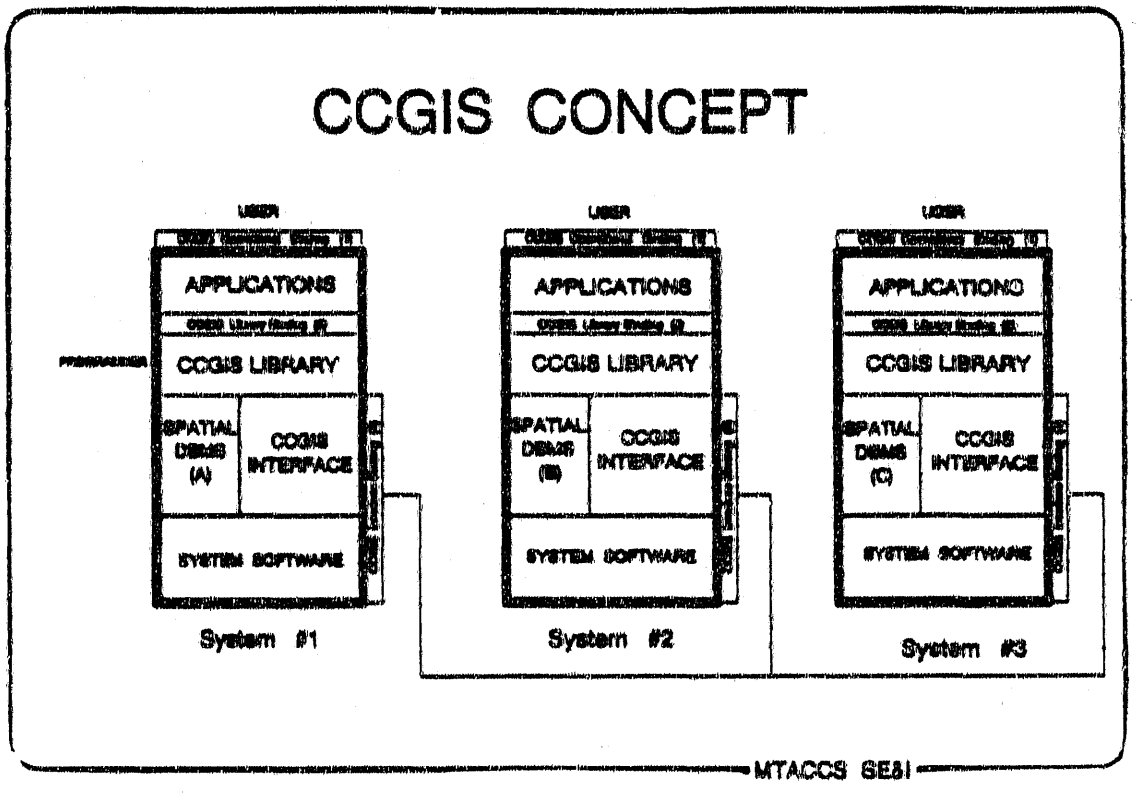

FIGURE 2. CCGIS Concept

- The Type 1 binding is the operational bindings. All functionality specific to the CCGIS and common to many C4I subsystems which interface directly with the user shall be consistent in operation and presentation and adhere to the COE Style Guide. For example, the zooming in on a displayed map may be incorporated in many TDAs. Each implementation of the zoom shall operate the same for all implementations. In the context of the CCGIS architecture, the Type 1 binding is specific to the interface between the user and CCGIS Layer 4 software.

- The Type 2 binding shall interface the application software with the CCGIS library. There shall be only one interface for any given capability or function. For example, each TDA calls the same CCGIS zoom software module to perform the zoom function. In the context of the overall architecture for the CCGIS, the Type 2 binding is the interface between the Layer 4, Applications, and the Layer 3, Command & Control Support Software.

- The Type 3 binding shall interface CCGIS components which operate concurrently on different C4I computer system implementations. The context of the CCGIS is a truly distributed software system and database for C4I systems. Thus one fielded system shall be able to access GIS data and software functionality on another totally separate system using the same software commands. In the context of the CCGIS, the Type 3 binding is the interface between different computer system (C4I system) implementations.

The types of bindings presented shall make possible the implementation of multiple commercial and public domain GIS engines as the CCGIS spatial DBMS engine. The functional requirements allow for this flexibility and for future resolution of the GIS engine selection during the official specification and design process.

3.1.5 **CCGIS Data Types.** An overview of the required basic CCGIS data types is presented here. A more detailed description of the CCGIS data model requirements is contained in Section 3.3.1. The CCGIS shall provide services for the following two basic data types.

3.1.5.1 **Vector.** A vector data structure is one method of representing cartographic data. For vector data, the cartographic features are represented by their entity description (i.e. feature/attribute codes) and their spatial extent (i.e. geographic coordinates). Vector data can be point, line, or polygonal information. A point feature is represented by a single set of coordinates. Lineal and real features are represented by a sequence of connected points or line segments. Vector data can be 'sequential' (alias spaghetti), 'chain node' or topological.

3.1.5.1.1 **Sequential Data.** Sequential data is vector data in which no spatial relationships are established between features. It is simply a sequence of points representing point, vector, or polygon data. An example is DFAD.

3.1.5.1.2 **Chain-Node Data.** A vector data in which the spatial extent of features is represented by "nodes" and line "segments" is known as Chain-node-data. Unlike sequential data, chain-node-data identifies the intersections of line segments. These intersections are referred to as nodes. Isolated point features are also represented as nodes. Linear and areal features are represented by a line segment at the nodes. Chain-node-data allows for identification of some adjacency information. It eliminates the problems of "slivers and gaps" and "color fill bleeding" common with polygon data represented in a sequential format.

3.1.5.1.3 **Topological Data.** Vector data which has the same characteristics of chain-node data but also establishes the spatial relationships (connectivity, adjacency and inclusion) between features is known as topological data. Topological data structures use nodes, edges and faces to represent the spatial extent of point, lineal and areal features respectively. Examples include MINITOPO, DLG, and DCW.

3.1.5.2 **Regular Gridded.** Regular gridded data is a collection of point data all of equal distance from each other and spaced uniformly on a cartesian grid. Relative to mathematics, it is an array of points. Regular gridded data points typically represent the cartographic value of that point (e.g., an elevation post or water depth). Regular gridded data has the following two forms.

3.1.5.2.1 **Cell.** The cell data form is regular gridded data where each point contains a unique value representing information for the area the cell covers. An example of cell data is the digital terrain elevation data (DTED) from the Defense Mapping Agency (DMA). Typically, DTED and DFAD cells are 1 degree by 1 degree, while LANDSAT cells are 30 minute by 30 minute.

3.1.5.2.2 **Raster.** The raster data form is a special case of cell data where each point contains a unique value representing an area of one pixel. Raster data for most applications relates to images. Raster data is just another form of the regular gridded data required in the CCGIS although it can be thought of as a special case of the cell data form. Raster data is typically used to record scanned maps and charts (e.g. MG&G graphic data), image data, or gridded data.

3.1.5.3 **Attributes.** Attribute information further describes the characteristics of a basic data type. An attribute is analogous to an adjective describing a noun in the English language. An attribute only has meaning when associated with a piece of data, such as the vector and/or regular gridded primitive data types described in section 3.1.5. Attributes shall provide display color information, greater description of the data from a dictionary, or linkage to additional data. A given data element shall be able to have at least 30 attributes associated with it. Types of attributes shall include characters, integers, real numbers, and categorical values.

3.1.5.4 **Overlays.** The aggregation of information having a common relationship forms an overlay. An example of an overlay is the collection of various obstacles, which is designated as an obstacle overlay. As a minimum, overlay shall consist of one basic type of data; either vector, cell, or raster. In the case of the example just cited, the data type was vector. An overlay may be built from data from any one of the basic data types. The CCGIS shall support many overlays (100 or more) which may include battlefield geometries, transportation routes, or any other data that the user can define and combine within the CCGIS spatial database.

3.1.5.5 **Attribute Dictionaries.** An attribute dictionary is a reference containing the descriptions for attribute information which further defines data contained within the CCGIS spatial database. Multiple attribute dictionaries shall be supported allowing users to create their own dictionary which can override the global dictionary established for a CCGIS installation.

3.1.5.6 **Text.** Any point (vector data type) shall be capable of having text information associated with it. Text information shall have font type, color, rotation, and size control associated with it.

3.1.5.7 **Symbol.** A symbol is an icon which can be attached to any point on the map. Like the basic data types, symbols can have attributes which describe them in greater detail. The symbol attributes can control the symbol size, color, rotation, and external database reference.

3.1.5.8 **Data Organization.**

3.1.6 **CCGIS Organization.** The CCGIS organization in the context of the functional requirements is presented in Figure 3. Five major categories of CCGIS functions are required. They are:

- Environment - the environment allows the user to define his world relative to the CCGIS. Thereafter, the system performs its functions and displays information in the context of the world defined by the user. For example, if one specifies distance in meters and a UTM projection, all subsequent functions performed by the system would use these to display information. In fact, the world defined by the user remains the default for that user until they change their environment.

- Data Management - the data management function provides all services specific to the importing of spatial data and the management of it once it is part of the CCGIS database. The capability to import DMA DTED data and validate the data's structure are examples of data management functions.

- Display - the display function provides all the services specific to the display, either visually or on a hardcopy device of any spatial or geographic information. The display of a map and selection of information to be displayed are examples of display functions.

- Edit - the edit function provides the tools to select any data item and permanently change it with regard to location or information content. Edit differs from the data selection function offered in display in that the edit changes are permanent in the database, whereas display allows for the selection of information solely for display purposes.

- Analysis - the performance of computations on the existing spatial data to generate new information is the analysis function. For example, one may use an application program whose algorithm manipulates three map overlays to compute a new overlay of information. Analysis differs from edit in that analysis uses algorithms to change many data items at once and it allows for the creation of new data sets.

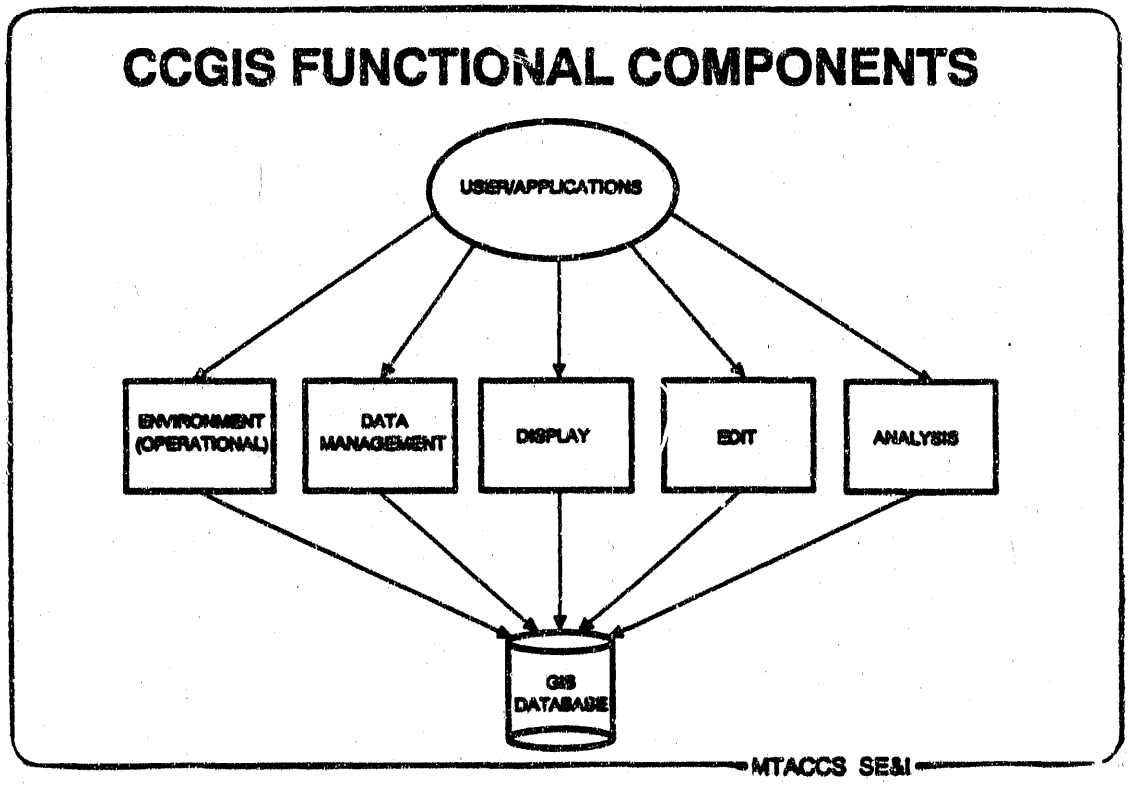

FIGURE 3. CCGIS Functional Components

This document also addresses the general CCGIS requirements common to all of the above functions and the overall implementation.

The CCGIS can be viewed within the context of the major software component requirements necessary to establish the CCGIS framework. Figure 4 presents a diagram of the major CCGIS software components (shaded area in diagram) established based on the functional requirements. The high level software component requirements are presented consistent with the adopted standards for the COE hardware/software architecture. Figure 4 shows the component relationships within the CCGIS layer structure.

There are no CCGIS-specific module requirements in Layer 1 of the architecture. The CCGIS is expected to operate on service equipment compliant with the COE standards.

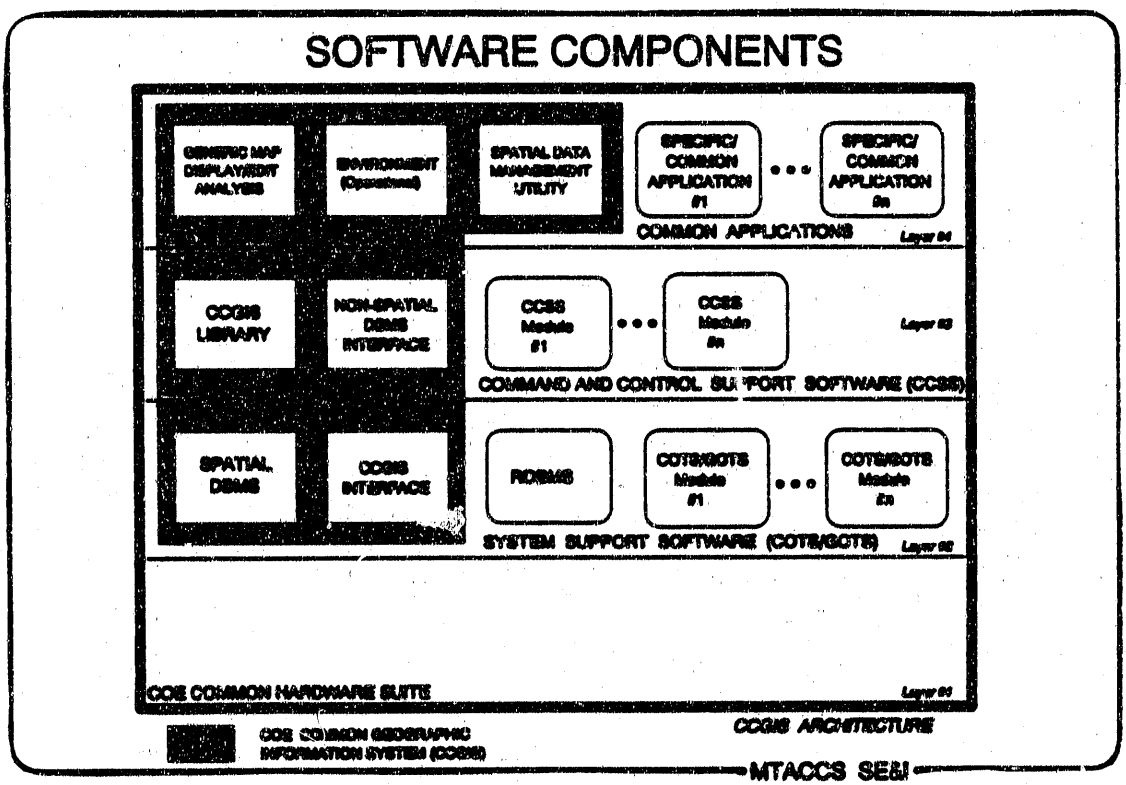

FIGURE 4. Major CCGIS Software Components

The CCGIS has two major modules in Layer 2 designated Spatial DBMS and the CCGIS Interface. These modules are transparent to the user. The Spatial DBMS is the fundamental software GIS database management system engine on which all CCGIS services are built. The CCGIS interface provides for the interface between various C4I systems and becomes critical if different COTS/GOTS GIS products are ultimately adopted for the suite of C4I implementations.

Layer 3 has two modules, the CCGIS Library and the Non-Spatial DBMS Interface. Again, these modules are transparent to users, but extremely important to application software developers. The Non-Spatial DBMS Interface coordinates data queries and data between the relational database management system (RDBMS) and the spatial DBMS. The CCGIS has one standard GIS library for all software developers to access.

Layer 4 presents three major CCGIS application software modules which interface directly with users of C4I systems incorporating the CCGIS concept. The Spatial Data Management Utility provides the user with tools to manage CCGIS information and to import information from other sources. The Environment (Operational) provides users with tools to tailor the system to operate in their world using terminology customized for their use of the system. For example, they can specify measure lengths in "meters" and projections in "UTM". Thereafter, the system operates using "meter" and "UTM" for their account until they change it. The "Generic Map Display/Edit/ Analysis" module will be the most frequently used CCGIS component in Layer 4 (Applications). It provides for the generic operation of the CCGIS functions on a map database without writing a customized application. Some will find this high level capability to display and manipulate maps very useful. Others will require the preparation of specific applications to simplify and customize the operation of their C4I system. In any case, only Layer 4 modules interface directly with the users of C4I systems.

3.2 **CHARACTERISTICS.** The capabilities and functionality defined hereafter are required for the CCGIS. The requirements will be presented by the functional organization.

3.2.1 **Performance Characteristics.** A description of the CCGIS performance characteristics follows.

3.2.1.1 **General Requirements.** Performance characteristics affecting CCGIS components and operations are presented here. The CCGIS shall operate on any military system conforming to the standards established by COE for the hardware environment. As such, CCGIS shall conform to all COE software and operating standards. A more detailed description of specific CCGIS requirements follows.

3.2.1.1.1 **CCGIS Hardware Interface.** The CCGIS shall operate in conjunction with or support output to the following devices.

3.2.1.1.1.1 Single Monitor Operation. A single monitor per user shall be implemented for the display and interaction with all graphics and textual information.

3.2.1.1.1.2 Mouse Input. The CCGIS shall allow the user to point at a location on a computer terminal screen to invoke an action via the use of a mouse or track ball device commonly available from commercial sources. This pointing at a screen location will be subsequently referenced as the cursor location for the remainder of this document. Thus, reference to cursor location implies the function requires the use of mouse input.

3.2.1.1.1.3 **Digitizing Tablet Input.** The CCGIS shall support the input of information via a digitizing tablet which supports as a minimum D size paper.

3.2.1.1.1.4 **Plotter Output.** The CCGIS shall support the output of vector spatial information on a plotter supporting a minimum of size hardcopy on both E size paper and transparency material. As a minimum, the plotter shall support HPGL commands.

3.2.1.1.1.5 **Color Hardcopy.** The CCGIS shall support the output of spatial information on a color hardcopy unit. The CCGIS shall be capable of producing paper and transparency products for any information which can be displayed on the supported computer monitor. A minimum of 300 dots per inch resolution is required.

3.2.1.1.2 **Response Time.** Functions requested by the user shall respond in two seconds or less, unless the function is designated as a utility. Most functions shall respond in less than one second. Functions designated as utilities shall provide the user with an estimated time of response.

3.2.1.1.3 **Data Compression.** All internal data transformations to the CCGIS shall be processed transparent to the user. Thus, automatic compression and decompression of data shall be performed without the user having to enter any specific commands. All compression schemes intended for use during direct user interaction, except for system backups, shall support near-real-time decompression. Two user selectable compression techniques shall be provided, one optimized based on time, the other optimized based on speed.

3.2.1.1.4 **Menu and Command Selections.** The CCGIS shall allow all user functions to be initiated via a user entered command or a menu selection. The user shall always be capable of entering commands to perform CCGIS functions.

3.2.1.1.5 **X-Windows.** The CCGIS functions shall be able to use all X-Windows and MOTIF functionality. For example, this provides the user with the capability to modify the size of the window being displayed.

3.2.1.1.6 **Multi-Tasking Implementation.** Major CCGIS functions shall be implemented as separate tasks so most can be performed concurrently. The CCGIS shall be event driven. For example, while a user is displaying a map, he or she could request to import new data.

3.2.1.1.7 **User/Software Developer.** CCGIS functions shall be made available to both the user and the software developer.

3.2.1.1.8 **Programming Languages.** All application programs shall be capable of accessing CCGIS library functions using either ADA or C. Software access through Fortran is also desirable.

3.2.1.2 **Environment - Operational.** The Environment requirements specify tools to establish information common to most CCGIS functions. The environment is intended to allow CCGIS users to set information parameters once. Thereafter, the CCGIS and C4I applications accessing the CCGIS continue to perform all CCGIS functions based on the information initially input by the user. Environment parameters may be established by the CCGIS user directly or via an application program which accesses an CCGIS environment software module. Once the environment is defined by the user, access of these functions is expected to be infrequent. Each user shall have the capability to specify user or application environment parameter precedence. A utility shall be provided for the database/system manager to set default environment parameters for groups of CCGIS users.

3.2.1.2.1 **Units of Measure.** The CCGIS shall provide the capability for users or application programs to select the input/output units of measurement for all functions and information to be displayed and/or processed. Applications shall be capable of overriding the user selection, but must notify the user of the fact that their selection has been overridden. The units to be supported shall include the following:

3.2.1.2.1.1 Lineal Measure - feet, yards, meters, kilometers, nautical miles, statute miles, and fathoms.

3.2.1.2.1.2 Areal Measures - acres, hectares, square miles (statute & nautical), square feet, square yards, square meters, and square kilometers.

3.2.1.2.1.3 Volume - cubic meters, cubic yards, cubic feet.

3.2.1.2.1.4 Bearing

- degrees based on magnetic north
- degrees based on true north
- radians based on magnetic north
- radians based on true north
- radians and degrees based on grid north

3.2.1.2.2 **Map Display Scale.** The CCGIS shall provide for the selection of the map display scale to be used. The CCGIS shall present the user with a set of scale selections from which the user can choose. The user shall be able to make a choice from the options or enter a totally new scale value. The most recently set scale becomes the default.

3.2.1.2.3 **Projections.** The user shall select the projection to be used for the first display. The grid associated with the selected projection shall be automatically linked based upon the geodetic rules (e.g. Universal Polar Stereographic Projection's grid is based on north of 84 degree or south of 80 degree). Thereafter, the system uses that projection until the user specifically requests a different projection. All projections both forward and reverse shall be based on DMA Technical Manual 8358 and DMA Technical Report 8350. The following projections shall be supported.

3.2.1.2.3.1 Universal Polar Stereographic
3.2.1.2.3.2 Universal Transverse Mercator
3.2.1.2.3.3 Lambert Conformal

3.2.1.2.4 **Area Of Interest (AOI).** The CCGIS shall support creation of Areas-Of-Interest (AOI) of any size with any combination of available input databases as selected by the user. The AOI is the contiguous portion of the overall database the general user wishes to access for further analysis, editing, exporting, or display.

3.2.1.2.5 **Area Of View (AOV).** The CCGIS shall support the creation of AOV of any size which is the portion (subset) of the AOI to be viewed initially by a user when they first display a map. The CCGIS shall use the AOV as the default area to be displayed unless the user specifically has performed a pan or zoom.

3.2.1.2.6 **User Skill Level.** The CCGIS shall allow the user to specify at least three operating skill levels: entry level (level 1), intermediate (level 2), and analyst (level 3). All CCGIS commands shall be identified with a skill level. Once a skill level is selected, the functions for the specified skill level or higher (numerically higher level number) shall be presented to the user for selection. The higher the skill level, the more functions the user has available for selection. A lower skill level means fewer choices. The CCGIS software shall allow the database/system manager to reassign the skill level for each major CCGIS function.

3.2.1.2.6.1 Beginner. Beginner features shall include those functions viable for the user who has minimal training. The beginner user shall be capable of displaying and editing maps.

3.2.1.2.6.2 Intermediate. The intermediate features shall include most functions required for general operation and shall be such that an infrequent semiskilled user can readily operate the system. The intermediate user shall have access to all display and basic analysis functions and the simple export/import utilities.

3.2.1.2.6.3 Expert. The expert features shall include all CCGIS functions and capabilities. A typical expert user would be the database/system manager.

3.2.1.2.7 Grids. The CCGIS shall allow users to select a specific computer generated grid or no grid to be displayed on the subsequent display of maps. Section 3.2.1.3.4 under the Display function provides more detail on grids.

3.2.1.2.8 Pick Control. Actual operation of the Pick is performed in the CCGIS Display function explained in Section 3.2.1.3.5. The following function parameters shall be selectable via the environment.

3.2.1.2.8.1 Pick Scope. Pick either from the information displayed, a specific overlay displayed, or the information in the AOV.

3.2.1.2.8.2 Coordinate Pick. The user shall be able to choose from either continuous display or demand display of the coordinate value.

3.2.1.2.8.3 General Pick. The user shall be able to choose from continuous display or demand for the general pick function.

3.2.1.2.8.4 Database Linkage. The user shall control the enabling or disabling of the display of other database information referenced by the object that was picked.

3.2.1.2.8.5 Accuracy Designator. The user shall control the enabling or disabling of the display of accuracy information for picks. Enable shall display the object positional accuracy as defined by the database. The accuracy designation is specified when the data is imported into the system. The CCGIS shall not compromise data accuracy as a result of internal computations.

3.2.1.2.8.6 Database Selection. The CCGIS shall permit the user to specify the database to be used for subsequent operations by database name (e.g. ADRG), and where appropriate, y product scale (e.g. 1:1M, 1:500K, 1:250K, and 1:50K). The use of scale selection permits further argumentation to zoom limitations of the originally selected data by providing a stair stepping effect to access larger scale or higher resolution data sets. This concept shall be applicable to raster data (e.g. DTED level 1 to DTED level 2) and vector data (e.g. DFAD 1C to DFAD 3C). The CCGIS shall also allow the user to specify a coordinate location or area, which results in a list of database names containing data for the area to be displayed, from which the user can make a final database selection.

3.2.1.2.9 **Map Display Configuration.** The user shall be able to tailor the basic display format (screen layout) for maps. The configuration capability shall allow configuration for monochrome video terminals, color video terminals, plotters, and MTACCs-specific graphic printers. It shall allow the specification of the following items.

3.2.1.2.9.1 **Borders.** The user shall be able to specify a border or no border.

3.2.1.2.9.2 **Legend Characteristics.** The user shall be able to specify a legend, no legend, and the layout of a legend if one is specified.

3.2.1.2.9.3 **Command Window Location for Video Screens.** The user shall be able to place the command window anywhere on the monitor.

3.2.1.2.9.4 **Video Characteristics (reverse video, regular video, monochrome).** Video characteristic options shall support all monitors to be supported by the COE standards.

3.2.1.2.9.5 **Default Map Overlays to be Displayed.**

3.2.1.2.9.6 **Grids.**

3.2.1.2.10 **Dynamic CCGIS Configuration.** The CCGIS shall provide automatic configuration of software based on the computer configuration. In addition, the CCGIS shall provide for dynamic software configuration based on those functions required at the designated installation. The user shall be capable of identifying functions on menus, commands, and data that they do not intend to use through an interactive configuration function. Once designated, the user shall be able to select reconfiguration, which shall tailor the software and databases for the installation with options for optimal performance, minimal computer memory, and minimal disk space.

3.2.1.3 **Display - Electronic Map Display Services.** The display function characteristics define all elements associated with the display and selection of information to be displayed by a user. Display includes both visual displays via computer monitors (CRTs, LCDs) and hardcopy output through plotters and printers. The user sets default parameters used for the display of information via the user environment function.

3.2.1.3.1 **Pan and Zoom.** The CCGIS shall provide the capability to pan (left or right, up or down) and zoom in or out with an infinite graduation of scale using the database specified in the operational environment and information displayed. For two dimensional displays, pan shall be provided in the vertical and horizontal directions. The effect to the user shall be equivalent to scrolling horizontally or vertically information on a computer monitor.

3.2.1.3.1.1 **Center and Extent Selection.** Using a graphic cursor (pointing device), the user shall be able to initiate a new map display by selecting from the existing map the desired center and the outer most point for the new map to be displayed.

3.2.1.3.1.2 **Center and Scale.** With a graphic cursor, the user shall be able to select the desired center of the new map to be displayed and then enter the specific map scale from the scale options displayed by the CCGIS. The options shall include the default scale, the last three scales selected, and those scales most frequently used. The user shall have the option of overriding the proposed scales by simply entering a complete scale factor.

3.2.1.3.1.3 **Center on User Specified Coordinates.** The user shall be able to enter a coordinate pair on which the system shall center the area of view.

3.2.1.3.2 **Variable Speed Pan.** The CCGIS user shall be able to pan in any direction using the arrow icon on the display. A separate pan speed icon shall appear on the screen once a pan arrow is selected, allowing the user to increase or decrease the "pan only" speed. The actual pan speed shall be displayed only when the user selects the speed icon. Selection of the icon shall also initiate the pan speed change process.

3.2.1.3.3 **Display Information Selection.** The CCGIS user shall have the capability to define and manipulate graphical displays. The intent of this function is to allow the user to tailor the display of information to suite the user's requirements.

3.2.1.3.3.1 **Overlay Selection.** The CCGIS user shall be able to select any combination of overlays to be displayed concurrently from a list of available overlays.

3.2.1.3.3.1.1 Overlay selection shall support a minimum of 100 overlays.

3.2.1.3.3.1.2 Multiple overlay selection of data shall be supported. The user shall have the capability to specify one of the overlays as background. This shall mean that its information display takes precedence over the display of other background overlays. In general users shall be capable of providing overlay layers and overlays.

3.2.1.3.3.2 Information Selection. The CCGIS shall allow the user to compose map displays interactively using the following selection techniques.

3.2.1.3.3.2.1 Attributes. The CCGIS shall allow users to tailor information to be displayed using boolean operators in conjunction with attribute names and/or attribute identifiers. At the CCGIS software library level, these capabilities shall be made directly available to application programs.

3.2.1.3.3.2.1.1 Boolean operators to be supported shall include as a minimum AND, OR, and NOT.

3.2.1.3.3.2.1.2 Attribute selections shall apply to changing the information to be displayed and the line type, line width, polygon pattern, and line color of information displayed. The attribute selection capability also applies to text and symbols.

3.2.1.3.3.2.2 Declutter. The CCGIS shall allow its data to contain a scale factor and to support the display of the corresponding information based on the current scale of the displayed information.

3.2.1.3.3.2.2.1 Declutter Enable/Disable. The user shall be capable of enabling or disabling the declutter feature.

3.2.1.3.3.2.2.2 Declutter Edit. The CCGIS shall allow the user to edit the declutter scale factor associated with data.

3.2.1.3.3.2.2.3 Declutter Factor Specification. The user shall be able to specify the declutter factor to be used for any given display. Thus, the user can override the declutter factor computed based on the scale of information to be displayed.

3.2.1.3.3.2.3 Selection Names. The CCGIS shall allow the user to create a selection name which retains all the selection information currently active. Future requests using a specified selection name shall invoke the selection criteria defined by that name immediately.

3.2.1.3.3.2.4 Overlays. An overlay consists of either user overlays, thematic layer, or image layer.

3.2.1.3.3.2.3.1 Selection Dictionary. The CCGIS shall maintain a selection dictionary with a capacity of at least 1000 selection names. The selection dictionary shall support all information display features.

3.2.1.3.3.2.3.2 Selection Dictionary Display. The user shall be able to request the display of selection names and their associated selection criteria.

3.2.1.3.3.2.4 Text. The user shall be able to enable or disable the display of text.

3.2.1.3.3.2.5 Symbols. The user shall be able to enable or disable the display of symbols.

3.2.1.3.4 Grids. The CCGIS shall support the display of grids on maps based on their corresponding projections.

3.2.1.3.4.1 Grids supported shall include the following:

3.2.1.3.4.1.1 Latitude/Longitude (degrees and radians)

3.2.1.3.4.1.2 Universal Traverse Mercator (UTM)

3.2.1.3.4.1.3 Military Grid Reference System (MGRS) as an extension of global UTM AND UPS.

3.2.1.3.4.1.4 World Geographic Reference System (GEOREF)

3.2.1.3.4.1.5 Universal Polar Sterographic

3.2.1.3.4.2 Grid Functions

3.2.1.3.4.2.1 The CCGIS shall display the grid specified through the operational environment. The CCGIS shall allow the user to select for display any one of the available grids or none of them.

3.2.1.3.4.2.2 The CCGIS shall allow the user to specify the grid size and grid labels.

3.2.1.3.4.2.3 The CCGIS shall allow the user to select the grid color and intensity.

3.2.1.3.4.2.4 All grid computations/conversions shall correspond to those identified in DMA TM-8358.

3.2.1.3.5 **Picks.** The CCGIS shall provide a pick capability so users can obtain more information on any object being displayed. Via the pick, the user shall be able to access any information on the object contained within the CCGIS database. The location of a pick is determined by the cursor location for the terminal being used. The cursor location is controlled by the use of a pointing device such as a mouse. The pick shall be initiated via the mouse button selection. Picks shall operate for all data types including vector and cell.

3.2.1.3.5.1 **Coordinate.** The coordinate pick shall display the coordinates of the cursor location in latitude/longitude (degree and radian) based on the current coordinate system (WGS 84) established for the C4I environment.

3.2.1.3.5.2 **Overlay Pick.** The overlay pick shall display the spatial database values and/or attributes of the object closest to the cursor. Overlay pick limits the objects that are considered to be the objects being displayed.

3.2.1.3.5.3 **General Pick.** The general pick shall display the spatial database value and/or attributes of the object closest to the cursor. The general pick differs from the overlay in that it considers all objects in the area of interest (AOI), even if they are not currently being displayed.

3.2.1.3.5.4 **Continuous Coordinate.** The coordinate values of the cursor location shall be displayed continuously. Continuous versus standard coordinate pick is established by the user in the operating environment.

3.2.1.3.5.5 **Continuous Pick.** The CCGIS shall display all attribute information related to the closest object to the cursor.

3.2.1.3.5.6 **Pick Database Linkages.** If the Pick database linkage is enabled in the users environment, the system shall also display the information from the database to which the object points. For example, a tank icon might reference, via attributes, a tactical database, where the specifics of its specification are contained.

3.2.1.3.5.7 **Accuracy Designation.** If the accuracy designator in the environment is set on for the user's account, the pick shall display the accuracy of the cursor's position in terms of the current coordinate system and the accuracy of the object value being displayed as provided in the objects database.

3.2.1.3.6 **3-D Displays.** The CCGIS shall provide the capability to display a 3-dimensional perspective view from any AOV. The user shall be capable of specifying the view angle, vertical exaggeration factor, view height, and lighting angle.

3.2.1.3.6.1 **Profile.** The CCGIS shall provide a wire mesh depiction of any regular gridded cell data for the area selected (Area of View - AOV). An example of cell data could be DTED elevation data. The mesh size and color shall be user selectable.

3.2.1.3.6.2 **Image Drape.** The CCGIS shall provide a 3-D depiction of a selected image data overlay on cell data for the AOV. For example, a picture of a map could be draped over the DTED data for that AOV.

3.2.1.3.6.3 **Zoom/Pick/Grid.** The zoom, pick, and grid functions previously described in display shall operate with the 3-D images generated.

3.2.1.3.7 **Legends.** The CCGIS shall provide the capability to create, edit, and display a legend for the display of any map on any support COE device. The purpose of the legend is to provide additional information on the map using color and/or line type coordination.

3.2.1.3.7.1 **Legend Enable, Disable, and Type Selection.** The CCGIS shall allow the user to enable or disable the legend and to specify either automatic legend selection or the specific legend to be used from a legend table.

3.2.1.3.7.2 **Automatic Legend Generation.** The CCGIS shall automatically generate a legend based on the information selected for display. The legend shall include map scale, time, date, and a brief description of each line type, pattern, and color derived from the overlay information. Basically, a description for each type of information displayed shall be provided in a manner color keyed to the actual information displayed.

3.2.1.3.7.3 **User Legend Specification.** The CCGIS user shall be capable of building his/her own legends, saving them in a legend table, and referencing them in the future. The legends generated shall be a template which can be used for any map display. The legends shall be capable of including feature names, feature data resolution, date of data sources, date, time, and display name. For data sources which have legends already defined, the CCGIS shall display the legend as defined in the database.

3.2.1.3.8 **Contours.** Contours contained within overlays and/or generated via the CCGIS analysis contouring function shall be capable of being displayed.

3.2.1.3.9 **Inset Map.** The CCGIS shall allow the user to create an inset map. An inset map is a view of a subset of the existing map database superimposed on the existing graphic display. The user shall be able to specify scale, center point location, size, and actual location on the screen.

3.2.1.3.10 **Color Display.** The CCGIS shall provide the capability to display color maps derived from its internal digital map database using the many Display and Edit functions specified for the CCGIS. The color displays shall only be limited by the color information contained within the database and constraints imposed hardware suite.

3.2.1.3.10.1 The CCGIS shall have the capability to display maps containing eight bits per pixel of color information. A minimum of 216 map colors and 40 graphic overlay colors must be supported.

3.2.1.3.10.2 The color map displays shall support the display of all CCGIS data types including vector, cell, and raster.

3.2.1.3.10.3 The CCGIS shall display map information in the color and patterns established for it via the attributes referenced through the attribute dictionary and the system color tables. Both the system color table and attribute dictionary shall further define color information for displays.

3.2.1.4 **EDIT - CCGIS Information Editor.** The Edit function shall provide the user tools to permanently change data in the CCGIS. The editor shall perform all of its functions concurrently while map information is being displayed and is intended to be integral to the map Display function.

3.2.1.4.1 **Add.** The user shall be able to add vector objects anywhere in the area of view or create a new file for the information being prepared. Addition of an object shall include the capability to add or define attributes, text, icon, color, line type, or other database references.

3.2.1.4.1.1 Spatial Data Objects. The CCGIS shall be capable of adding all vector data type objects.

3.2.1.4.1.1.1 Points. The CCGIS shall allow the addition of a point to the database by selecting a position with the cursor and invoking the Add function.

3.2.1.4.1.1.2 Lines. The CCGIS shall allow the addition of lines to the database by selecting a sequence of positions on the screen with the cursor and invoking the Add function.

3.2.1.4.1.1.3 Polygons/Complex Polygons. The CCGIS shall provide the following tools for specifying polygons using the Add function:

3.2.1.4.1.1.3.1 Regular Polygons. The CCGIS shall provide for specification of polygons from regular shapes including: circles, ellipses, rectangles, rounded rectangles, and triangles using major/minor axis, radius, and x/y distance techniques.

3.2.1.4.1.1.3.2 Irregular Polygons. The CCGIS shall allow users to create irregular polygons by picking lines and then requesting a polygon create function which shall close the polygon. The user shall also be able to create an irregular polygon by simply drawing the line sequence with the editor and requesting the polygon create function which automatically closes the polygon and generates it in the database.

3.2.1.4.1.1.3.3 Patterns. A minimum of 12 polygon fill patterns shall be provided in the add polygon capability, including solid, cross hatch, and dot patterns. The users shall have the capability to create their own fill patterns with the editor for later reference.

3.2.1.4.1.2 Text. The CCGIS shall support the assignment of Text to any point including text attributes. The user shall be able to specify the text font, color, rotation, and size attributes. These text features are limited to text contained within the CCGIS database. Text contained in other databases may not have these CCGIS text display features.

3.2.1.4.1.2.1 A minimum of five text fonts shall be supported including a sans serif, one bold and one italic font.

3.2.1.4.1.2.2 The text-size control shall be selectable between fixed size and variable size with zoom.

3.2.1.4.1.2.3 The text capability shall offer size display control based on a designated attribute value.

3.2.1.4.1.2.4 The text shall offer color control based on a reference color table and attribute value.

3.2.1.4.1.3 Symbols. Icons shall be capable of being prepared with the standard CCGIS editor used to provide all editing functions. No special skills beyond the standard editing shall be required to prepare a Symbol. The Symbol add function shall offer the following capabilities.

3.2.1.4.1.3.1 When adding or changing a symbol, the symbol size control shall be selectable between absolute size and relative size with zoom.

3.2.1.4.1.3.1.1 Absolute Symbol scaling shall provide for the same size Symbol no matter what zoom/rescaling function is initiated (symbol stays the same size).

3.2.1.4.1.3.1.2 Relative Symbol scaling shall provide for the icon to reflect the scale of the zoom/rescaling function (symbol gets larger and smaller).

3.2.1.4.1.3.2 The add and change function shall allow the user to specify the object attribute to be used for the size control for relative symbol scaling.

3.2.1.4.1.3.3 The add and change function shall allow the user to specify the attribute and color tables used for color control based on attribute value.

3.2.1.4.1.4 Database Links. The CCGIS shall allow for linking any spatial object to another database such as a tactical database which may be separate from the CCGIS spatial database. Multiple database linkages shall be allowed. The user shall be able to specify the linkage during the object edit process including during the add or change function.

3.2.1.4.2 Delete. The user shall be able to select any vector object in the area of view for deletion.

3.2.1.4.3 Move. The CCGIS shall allow the user to move any spatial data object including symbols and text to any location within the area of view. The user shall be able to pick the object, then pick its new location, or enter a new location using coordinates based on the coordinate system currently in effect.

3.2.1.4.4 Change. The CCGIS shall allow the user to change any of the descriptors for any spatial data object. When the change is requested, all object information shall be displayed so the user can move quickly to the desired information to make the change or addition. The change function allows for the change of the object attributes, color, and data references.

3.2.1.4.5 Copy. The CCGIS shall allow the user to copy any spatial data object including symbols and text to any location within the area of view. The user shall be able to pick the object, then pick its new location, or enter a new location using coordinates based on the coordinate system currently in effect.

3.2.1.5 Data Management - Geographic Database Reference Sources and Import Utilities. The CCGIS shall provide software utilities to allow the CCGIS database/system manager to import (transfer) reference GIS type data from outside sources directly into the CCGIS database. Once the data is imported, the CCGIS shall be capable of performing all CCGIS functions for the given data type on the imported information.

3.2.1.5.1 **Import Data.** The CCGIS shall provide the capability to import data directly into the CCGIS database from the distribution media provided by the data's source. The CCGIS user shall not have to depend on outside computing resources to perform the importing of the data. The import data capability shall be provided in the form of utilities which are not required to conform to the general two second response time specification. The CCGIS shall be capable of importing data from the following sources:

3.2.1.5.1.1 Digital Feature Analysis Data (DFAD), levels 1, 1C, 2, 3C.

3.2.1.5.1.2 Digital Terrain Elevation Data (DTED), levels 1, 2.

3.2.1.5.1.3 World Vector Shoreline (WVS).

3.2.1.5.1.4 Digital Chart Of the World (DCW).

3.2.1.5.1.5 World Data Bank II (WDB II).

3.2.1.5.1.6 Tactical Terrain Data (TTD). Note that Interim Terrain Data (ITD) may be substituted if the TTD data standard is not in place at the time of software delivery.

3.2.1.5.1.7 Digital Vertical Obstruction File (DVOF).

3.2.1.5.1.8 Vertical Obstruction Data (VOD).

3.2.1.5.1.9 Probabilistic Vertical Obstruction Data (PVOD).

3.2.1.5.1.10 Digital Air Field Information File (DAFIF).

3.2.1.5.1.11 Electronic Chart Update Manual (ECHUM).

3.2.1.5.1.12 ARC Digitized Raster Graphics (ADRG).

3.2.1.5.1.12.1 The CCGIS ADRG import utility shall support direct access/import of colors and MG&G raster Graphics data in 24 bits RGB format. Internal CCGIS RGB data shall be reduced to 127 dots per inch (spatial) with user selectable options for color compression among 24 bits, 4 bits, and 8 bits. For output to other systems, the CCGIS shall provide color and spatial data reduction from 254 dots per inch to specified Service standards (e.g. 127 dots per inch), and color compression to 8 bits (U.S. Navy and U.S. Air Force) or 4 bits (U.S. Army).

3.2.1.5.1.12.2 The CCGIS ADRG import utility shall support pixel reduction from 254 dots/inch to a user selectable number of dots/inch.

3.2.1.5.1.12.3 The CCGIS ADRG import utility shall support the conversion of all chart specific and general chart class information to attributes associated with any map data found in the on-line database.

3.2.1.5.1.13 Digital Point Positioning Data Base.

3.2.1.5.1.14 SPOT/LANDSAT.

3.2.1.5.1.15 Spatial Data Transform Format (SDTS).

3.2.1.5.1.16 Prototype. The CCGIS shall be programmable to adapt to new data formats.

3.2.1.5.2 Import Criteria. The CCGIS import utilities shall perform the import of data under the following conditions.

3.2.1.5.2.1 The CCGIS shall provide the capability to input all data set features and attribute information contained within the referenced data source imported.

3.2.1.5.2.2 The import utility for all designated data sources shall allow attribute information associated with either a specific feature or classes of features to be selectively input and remain associated with its original piece of information in the CCGIS database.

3.2.1.5.2.3 The import utility for all data sources shall provide the capability to selectively input any of the information found in the specific data set header information including accuracy, resolution, feature quality, security, and names.

3.2.1.5.2.4 The import utilities for all data sources shall perform their function without the need for the user to write computer code.

3.2.1.5.2.5 The CCGIS import utilities shall perform their function directly from distribution media provided by the data source.

3.2.1.5.2.6 The CCGIS import utilities shall perform reference system conversions in accordance with DMA TR-8350.2 for all input and on-line databases.

3.2.1.5.2.6.1 The CCGIS user shall be able to specify the original ellipsoid and/or datum and the target ellipsoid and/or datum. Thus, the conversion utilities shall support direct datum conversion.

3.2.1.5.2.6.2 The target spheroids and datums shall be selectable from an established standard list or the default for the existing on-line database shall be used.

3.2.1.5.2.6.3 Coordinate transformation capability shall support manually input information via the CCGIS editor (one or more points), and internal coordinate transformation for existing databases.

3.2.1.5.2.7 All CCGIS import utilities shall store imported data in the basic data type formats established for the CCGIS.

3.2.1.6 **Data Management - Geographic Database Services.** The CCGIS shall provide complete data management resources for the user to maintain and support on-line and off-line databases and their linkage to other databases.

3.2.1.6.1 **Database Manager.** The CCGIS shall provide database manager functions which perform the following for any selected database.

3.2.1.6.1.1 Display the database name, location (off-line/on-line), source, security level, source scale, data type, and other pertinent general database information. The database display list shall be capable of being sorted by database name, off/on-line, database type, and scale.

3.2.1.6.1.2 Display on-line storage requirements for each database in bytes.

3.2.1.6.1.3 Display off-line storage requirements for each database in bytes including the date and time of the last off-line information update.

3.2.1.6.1.4 Display graphically a base map for the database showing areas which have data coverage with one fill pattern for each unique database feature. Areas which do not have data shall be displayed with a different color and fill pattern. The fill patterns/colors and the base map shall be user selectable at the time the base map is created or updated.

3.2.1.6.1.5 Export Data. A function shall be provided to export data off-line to media compliant with the COE standards. This function shall aid the user through the complete data export process. When initiated, the function shall give the user an estimate for the amount of media required and the wall clock time to perform the export.

3.2.1.6.1.6 Rename a database.

3.2.1.6.1.7 Delete a database.

3.2.1.6.1.8 Move a database to a selected device and specified area on the device.

3.2.1.6.1.9 Perform database file maintenance to optimize the database and eliminate fragmentation of databases.

3.2.1.6.1.10 Provide the capability to interactively backup/restore selected databases to/from removable storage media. Backup/restore shall be capable of being performed concurrently with other system and user functions.

3.2.1.6.1.11 Provide automatic incremental and complete backup capabilities for data to off-line media. The user shall have the capability to schedule these activities by time of day and specific dates.

3.2.1.6.2 Dictionary Manager - Attribute/Icon/Feature/Database. As a minimum, the CCGIS shall provide services to maintain and update all of the CCGIS dictionaries including attributes, features, databases, and Symbols. It shall accomplish the following functions.

3.2.1.6.2.1 Print the complete dictionary in a format that is readable by the database manager. All information associated with a dictionary entry shall be included.

3.2.1.6.2.2 Create/edit/delete dictionary items and descriptors associated with a dictionary entry.

3.2.1.6.2.2.1 The symbol dictionary graphical entries shall be made consistent with the use of the CCGIS editor.

3.2.1.6.2.2.2 All dictionary functions shall be implemented in a consistent manner.

3.2.1.6.3 System/Database Management Utilities. Utilities shall be provided for the general setup of a database for a new user account, to validate database integrity with regard to the CCGIS data model, and to establish default parameters for groups of CCGIS components.

3.2.1.6.3.1 The System Management Utility shall provide for the creation and update of global parameters which are used as default for the CCGIS system.

3.2.1.6.3.2 The System Management Utility shall provide for the creation and update of group parameters which apply to designated user groups.

3.2.1.6.3.3 **Diagnostic Utilities** shall be provided to validate CCGIS database integrity. The utilities shall detect invalid and incomplete data with regard to the data structure rules and provide a method for removing or correcting the data in question.

3.2.1.6.4 **Display Image File Copy.** The user shall be capable of storing the image of any CCGIS display to disk for later retrieval. Actual retrieval and display and the organizing of many image copies for presentation shall be provided.

3.2.1.7 **CCGIS Analysis Functions.** The CCGIS analysis functions process CCGIS data creating a new database, overlay, or dataset. Analysis functions shall be available to all applications. In general, analysis functions take more time to perform than the other CCGIS functions.

3.2.1.7.1 **Vector Data Analysis.** The CCGIS shall perform the following functions for a specified AOI, database, or polygonal area specified on a graphics display for all user designated features.

3.2.1.7.1.1 **Weeding.** The CCGIS shall have a utility to remove redundant/ unnecessary data points that fall within a specified threshold for a selected AOI and database. Weeding shall be user selectable. GIS functions incorporating weeding shall not perform like a utility when weeding is disabled.

3.2.1.7.1.2 **Straining.** The CCGIS shall have a utility to remove vector data objects (linearly and by area) according to a size threshold input by the user.

3.2.1.7.1.3 **Linear Join.** The CCGIS shall have a utility to combine lineal feature endpoints for vector data that fall within a spatial separation threshold.

3.2.1.7.2 **Contouring.** The CCGIS shall provide contouring for cellular data such as DTED.

3.2.1.7.2.1 The user shall be able to select contouring intervals, contour line colors and type, and contour labels.

3.2.1.7.2.2 The user shall be able to select the reference cell value or in the case of DTED, the base elevation.

3.2.1.7.2.3 The derived contour data shall conform to the vector database format and have an associated elevation value assigned as an attribute.

3.2.1.7.2.4 The user shall be able to designate overlays for the output of the contour function. Thus, contouring output can be manipulated and displayed like any other vector data overlay.

3.2.1.7.3 **Complexing.** Aggregate complexing of multiple cell or polygonal overlays shall be provided. Complexing differs from data and overlay selection in that complexing creates new data in the CCGIS database.

3.2.1.7.3.1 Cell complexing.

3.2.1.7.3.2 Polygon complexing.

3.2.1.7.4 **Regular Gridded Data Sampling.** The CCGIS shall offer the creation of new temporary datasets, overlays, or new regular gridded databases by the selection of reduced resolution from existing specified regular gridded databases. The sampling capability shall have the following features.

3.2.1.7.4.1 Average/Median/Maximum/Minimum cell value determination.

3.2.1.7.4.2 Target dataset specification based on point spacing.

3.2.1.7.4.3 The resulting data sampling product shall retain both value (vertical accuracy in the case of elevation data) and horizontal accuracy with regard to position at any resolution.

3.2.1.7.5 **Raster Data Analysis.** Raster data analysis functions are functions dedicated to the processing of image data. Basic image processing and image enhancement functionality, such as contrast stretching, shall be provided.

3.2.1.8 **Applications - Decision Support.** Applications are one of many functions which focus on a particular and use of the CCGIS. Unlike the general CCGIS analysis functions, applications shall be performed quickly and be available for interactive use. Applications shall generate displays for immediate viewing and overlays in the form of products which can be used at a later date by other CCGIS functions or applications. The output of one application may be an overlay which can become an input to another. For applications using elevation data, the highest resolution DTED data available shall be supported. A description of generic applications that shall be integral to the CCGIS follows. Keep in mind that many additional applications for specific C4I systems will be tailored for field use beyond what is provided with the basic CCGIS.

3.2.1.8.1 **Terrain Masking.** The CCGIS shall compute a graphical terrain mask for multiple ground sensors and/or for an arbitrary air/ground path lineal feature. The terrain mask shall be displayed immediately for the users viewing, and also stored in an overlay for future use by other applications or CCGIS functions.

3.2.1.8.1.1 The terrain masking calculations shall accommodate sensor's height and type.

3.2.1.8.1.2 The "Seafar" or a technically superior algorithm shall be used for calculations.

3.2.1.8.1.3 The terrain masking functions shall take into account the earths curvature through the use of selectable standard spheroids which are made available for selection by the users.

3.2.1.8.1.4 The functions shall compute masks for any terrain-shadowed area elevation including ground level.

3.2.1.8.1.5 Air path mask computations shall be selectable for any altitude (AGL and MSL).

3.2.1.8.1.6 Terrain masking calculations shall be performed with respect to arbitrary points on the ground or in the air. Point selection shall be available via the use of picks on features displayed on maps.

3.2.1.8.2 **Weapon/Sensor/Radio Analysis.** The CCGIS shall perform multiple site weapon/sensor/radio analysis and provide outputs in the form of map overlays and the immediate display of results.

3.2.1.8.2.1 The CCGIS shall provide a color contoured map overlay indicating minimum unmasked altitude of combined sensors.

3.2.1.8.2.2 The CCGIS shall provide a color coded contoured map overlay indicating redundancy of coverage by combine sensors.

3.2.1.8.2.3 The CCGIS shall provide overlapping range versus azimuth contours for a given AGL altitude of a target or radio mast.

3.2.1.8.2.4 The CCGIS shall provide a contoured map indicating probability of kill by the combined weapons systems selected by the user.

3.2.1.8.3 **Line-of-Sight (LOS).** The CCGIS shall compute point-to-point LOS using target height, sensor height, full resolution DTED elevation data, feature data, and 3-D range. LOS computations shall consider the earth's curvature by allowing users to select standard spheroids.

3.2.1.8.3.1 The LOS functions shall prepare a product which allows the LOS to be displayed using the CCGIS 3-D profile display function.

3.2.1.8.3.2 Horizontal and vertical labelling shall be generated based on the CCGIS automatic labeling features or labels selected by the user.

3.2.1.8.4 Elevation Data Analysis. The application shall display elevation information depicted in contours using the CCGIS contouring analysis features and DTED data. As a minimum, the user shall be able to select scale, AOI size, base elevation, number of intervals, interval size, and interval colors and patterns for areas between the contours.

3.2.1.8.4.1 The application user shall be able to obtain the minimum and maximum elevations in the terrain database being accessed.

3.2.1.8.4.2 The application shall have the capability to produce, display, and save relief shaded (light source shaded) depictions of the terrain elevation data in 2-D (plan view).

3.2.1.8.4.3 The application shall be capable of displaying relief depicted images of the area of view using the selected elevation data to determine the relief lighting taking into account the light source (i.e., sun, moon) and position by date/time or arbitrary placement (i.e., azimuth and delineation).

3.2.1.8.5 Other Terrain Analysis.

3.2.1.8.5.1 The CCGIS shall produce for viewing a heading between two geographic coordinates with reference to either true or magnetic north. The function shall comply with DOD Technical Note TN 8222-01-87.

3.2.1.8.5.2 The CCGIS shall perform precise monoscopic positioning based on ARC (geocoded) Digital Raster Imageries (ADRI).

3.2.1.8.5.2.1 The CCGIS shall derive positional coordinates for selected points.

3.2.1.8.5.2.2 The CCGIS shall calculate and display absolute point position error at 90% circular (CE), linear (LE), and spherical error (SE).

3.2.1.8.5.3 The CCGIS shall calculate distance by combining/utilizing great circle and straight line-of-sight (LOS) techniques.

3.2.1.8.5.3.1 The technique used shall be user-selectable via the operational environment or automatically provided, depending on distance measurement desired. If measurement includes a change in altitude, the LOS technique shall be used. If a measurement is at a common elevation, the great circle technique shall be used.

3.2.1.8.5.3.2 This function shall measure ground features or arbitrary ground paths.

3.2.1.8.5.3.3 This function shall be available with the general CCGIS display function.

3.2.1.8.5.4 Threat/Sensor Analysis. The Threat/Sensor Analysis function shall provide the capability to automatically simulate the relocation of threats/sensors to optimize the area visible to that threat/sensor.

3.2.1.8.5.4.1 The analysis shall be performed on areas found within the threat's/sensor's location error ellipses.

3.2.1.8.5.4.2 The analysis needs to include, as a minimum, DTED data.

3.2.1.8.5.4.3 The threat analysis function shall allow for sensor/threat item selection (one or more) from the CCGIS spatial database or databases to which the spatial database links.

3.2.2 System Capability Relationships.

(This paragraph is not applicable to the specification.)

3.2.3 System Interface Requirements. The CCGIS is a software component of the COE standards. As such, the CCGIS software shall use other COE approved software subcomponents to perform non-GIS-specific functions already provided through COE. Figure 1 in Section 3.1.1 and Figure 4 in Section 3.1.5 show the CCGIS relationship to other COE components.

3.2.4 Physical Characteristics. The physical characteristics for the CCGIS are constrained by the COE standards of which the CCGIS is one component. The CCGIS shall use the hardware and corresponding physical characteristics defined by COE standards.

3.2.5 System Quality Factors. The CCGIS shall adhere to the quality factors specified in the COE standards.

3.2.6 Environmental Conditions. The CCGIS shall meet the environmental conditions established in the COE standards.

3.2.7 Transportability. The CCGIS shall meet the transportability requirements established in the COE standards.

3.2.8 **Flexibility and Expansion.** The CCGIS shall meet the flexibility and expansion requirements established for COE for computer hardware and software. More specifically, the CCGIS software shall allow for functional operation using a database in the gigabyte range. The CCGIS data structures and software shall support databases which exceed a terabyte. The CCGIS shall allow for the extraction of databases from existing databases and the creation of totally new databases.

3.2.9 **Portability.** The CCGIS shall meet all the portability requirements defined by the COE standards. The CCGIS shall operate in the computing environment defined by the COE standards. Binding types defined in Section 3.1.4 and shown in Figure 2 shall allow for the exchange of the spatial database management system software and the application software which access the CCGIS. Such exchanges should not require modifications to other software components which access the CCGIS for spatial or geographic data management and display services. The only exception is that old databases may need to go through a conversion process prior to use with replacement software.

3.3 **DESIGN AND CONSTRUCTION.** The CCGIS shall conform to the general design and construction requirements established by the COE standards of which CCGIS is a subcomponent. As such, the CCGIS fits within the COE software architecture which defines the software design framework. One additional design requirement for the CCGIS is the spatial data model.

3.3.1 **Materials/Data Model.** The CCGIS shall meet the material requirements defined by the COE standards. One additional design/material requirement for the CCGIS is the spatial data model. The power of any geographic information system is constrained by the data model on which the GIS computer code operates. For this reason, the data model constraints are presented.

3.3.1.1 **Data Model Design Availability.** The spatial data model design and corresponding documentation shall be available to the CCGIS software developers and C4I users.

3.3.1.2 **Common Data Format.** All data types from external sources shall be reformatted into a common format of structure and attribution. The level of attribution shall be that of the most extensively attributed input database.

3.3.1.3 **Reference Coordinate System.** The CCGIS data model for all data types (vector, cell, raster) shall have one internal reference data coordinate system which can accurately represent information datasets anywhere in the world and any one dataset shall be allowed to include the complete area of the earth.

3.3.1.4 **Data Organization.** The CCGIS data model shall allow for the user to group data. Data groups which users can reference during system operation shall be established for overlays, a collection of information to be reference in displays, and themes, groups of data having a common thread.

3.3.1.5 **Seamless Database.** The CCGIS data model shall support a seamless spatial database. Access of data through programs or end user operation shall be achievable through a coordinate system reference and not require the identification of specific files or map sheet names. The database shall retain the capability of being accessed via the use of DMA-specified map sheet numbers.

3.3.1.6 **Spatial Data Objects.** The CCGIS spatial vector data objects shall support the following five categories of information: geometry, topology, spatial characteristics, display parameters, and attributes. Cell and raster data objects shall, as a minimum, support attribution and display parameters.

The CCGIS spatial vector data objects shall support the following five categories of information: geometry, topology, spatial characteristics, display parameters, and attributes. Cell and raster data objects shall, as a minimum, support attribution and display parameters.

3.3.1.7 **Coordinate Conversion.** All CCGIS grid computations/ conversions supplied in accordance with Paragraph 3.2.1.3.4 shall be designed as separate software modules that can be directly accessed by computer software written in Ada. The software modules shall be separable from the main software system, so that they can be incorporated into other software systems which do not require the complete GIS. Basically one shall be able to supply the software a source coordinate and coordinate reference system and expect in return the new coordinate in the specified target coordinate reference system.

3.3.2 **Electromagnetic Radiation.** The CCGIS shall meet the electromagnetic radiation requirements established by COE.

3.3.3 **Nameplates and Product Markings.** CCGIS products shall be delivered with markings in accordance with DI-H-5545.

3.3.4 **Workmanship.** The CCGIS shall meet the workmanship requirements established by COE.

3.3.5 **Interchangeability.** The CCGIS shall meet the interchangeability requirements established by COE.

3.3.6 **Safety.** The CCGIS shall meet the safety requirements established for COE.

3.3.7 **Human Engineering.** The CCGIS shall meet the human engineering requirements established for COE. Of particular concern is that the CCGIS shall operate in conformance with the COE Style Guide and that all graphical and textual interactions be consistent across all CCGIS and COE specified functions. While the human interaction with map and spatial displays may differ from the other COE specified functions, the interaction methodology shall be consistent across all CCGIS functional components.

3.3.8 **Nuclear Control.** The CCGIS shall meet the Nuclear Control requirements established for COE.

3.3.9 **Security.** The CCGIS shall conform to all security requirements established by COE. In addition, the CCGIS shall allow for security keys by database and overlays. The CCGIS shall also allow for approved users to construct a key dictionary which specifies the keys authorized for a specific computer account. Access to the user key dictionary shall have a unique key. The unique key is expected to be provided only to computer database/system management personnel.

3.3.10 **Government Furnished Property Usage.** The CCGIS, like C4I applications, shall use the MCASS software developed to date. Use of this software shall take precedence to developing any new software or the use of other software components.

3.3.11 **Computer Resource Reserve Capacity.** The CCGIS computer resource reserve capacity requirement is constrained only by the COE standards.

3.4 **DOCUMENTATION.** CCGIS documentation shall conform to DoD-STD-2167A, MIL STD 490A, and associated Data Item Descriptions (DIDs). Complete documentation shall be provided such that organizations receiving the CCGIS can install it, operate it, and train others on its operation and use. The software shall include online documentation access; that is, the ability to query and display document pages.

3.4.1 **CCGIS Documents.** The CCGIS documents shall include, but not be limited to the following.

3.4.1.1 **CCGIS Design Document.** The software design and data structures shall be documented. Sufficient documentation shall be provided such that a professional computer scientist trained in UNIX can understand the overall design with an effort of 15 days or less. The use of professional software documenting tools, such as Structure Charts and dataflow diagrams, shall document the CCGIS design. All data structures shall be fully documented and non-proprietary.

3.4.1.2 **CCGIS Software Installation Guide.** The installation guide shall provide instructions such that a professional software developer may install the software on a qualified MCASS computer system. The guide shall also provide adequate information to install multiple computer accounts for users and baseline databases necessary to demonstrate all major components of the CCGIS.

3.4.1.3 **CCGIS Operations Guide.** Complete instructions shall be provided for the operation of all major features provided by the CCGIS.

3.4.1.4 **CCGIS Software Developer Guide.** Complete instructions shall be provided for software developers who prepare application programs (Tactical Decision Aids) using the CCGIS software components. All software modules intended for software developer access shall be fully documented so that professional software developers can effectively use them. A sample application program shall be provided with instructions telling how the CCGIS software components were used and the general programming practices recommended for using the CCGIS software library.

3.4.1.5 **CCGIS Tutorial Guide.** A computer tutorial which operates on the MCASS equipment shall be provided to instruct personnel on the operational use of the CCGIS software.

3.4.1.6 **In-line Code Documentation.** All software modules except for the operating system and language compilers shall have header information conforming to the configuration management plan for the development of the system. As a minimum, the header record shall identify the module function to be performed, the inputs, outputs, author, and dates of change.

3.4.2 **CCGIS Electronic Documentation.** User documentation shall be maintained electronically on systems containing the CCGIS software. The following capabilities shall be provided.

3.4.2.1 **Manual Printing.** The user shall be capable of printing the user and software developer guide directly from the system containing the software.

3.4.2.2 **On-Line Help.** If the user requests more help than the on-line help feature can provide, the software shall reference the most appropriate page of the user guide and display it.

3.5 **LOGISTICS.** The CCGIS logistics requirements are defined by COE standards.

3.6 **PERSONNEL AND TRAINING.**

3.6.1 **Personnel.** The CCGIS is an integral component of the COE standards which is actually implemented through C4I systems. The CCGIS shall not require additional personnel to operate the functions it provides for C4I systems. Likewise for hardware maintenance, the CCGIS shall not require additional personnel since the CCGIS operates on C4I supplied equipment which already must be maintained regardless of the CCGIS. The CCGIS concept is that existing combat and marine support personnel shall utilize the CCGIS as a tool to perform their ordinary daily work. Additional personnel requirements shall be limited to the following.

3.6.1.1 **Software Maintenance Personnel.** Additional operating personnel requirements shall not exceed two full time equivalent (FTEs) computer scientists to maintain the CCGIS software package for the suite of C4I systems.

3.6.1.2 **Training Personnel.** Training personnel shall be provided to train staff on the operation of the CCGIS (see the Section 3.6.2).

3.6.1.3 **Data Preparation Personnel.** Because the potential application of CCGIS is so diverse, additional requirements for data preparation personnel are possible. The intent of the CCGIS is to use data supplied by outside sources such as the Defense Mapping Agency. If these sources cannot supply the data required, additional personnel resources shall be provided to prepare the data.

3.6.1.4 **Database/System Manager.** The additional data manager requirements shall be such that the C4I database/system manager can assume the additional database/system management requirements.

3.6.2 **Training.** Training shall be supplied for all CCGIS user categories. Computer aided instruction (CAI) shall be supplied with the software for all user operational training. Since infrequent training is expected, except for initial training, the use of qualified contracting personnel or software/system developers is recommended initially to train Marine staff who in turn would train other Marine personnel.

3.6.2.1 **Operational Training.** The CCGIS shall allow for any Marine to learn how to operate it with a maximum of one week of training. Operations shall include the display of maps, and the operation of tactical decision aids. The training shall be based on the fact that the personnel already know how to use the manual versions of the decision aids.

3.6.2.2 **Database/System Manager Training.** Training for actual building of databases shall not require more than one additional week for staff having formal computer training and/or extensive direct electronic mapping experience. CCGIS system specific training beyond the system training already required for other C4I systems shall not exceed one week. Thus total database/system training shall not exceed two weeks.

3.6.2.3 **Software Developer Training.** The training of personnel to write application programs utilizing the CCGIS shall not require more than three weeks. Personnel to be trained shall have at least two years of formal computer programming training or direct programming experience in a UNIX environment using ADA and C.

3.7 **CHARACTERISTICS OF SUBORDINATE ELEMENTS.** There are no subordinated CCGIS segments.

3.8 **PRECEDENCE.** The MCASS requirements shall take precedence to requirements contained herein.

3.9 **QUALIFICATION.** CCGIS shall be qualified through the use of pre-defined sets of qualification methods established by MCASS and implemented via the MCASS configuration management plan.

3.10 **STANDARD SAMPLE.** CCGIS shall have a formal standard test database sample for software testing purposes. The sample shall exercise all CCGIS components and data types using typical and very large datasets.

3.11 **PREPRODUCTION SAMPLE.** All CCGIS software releases shall be tested using the standard sample database using the test plan controlled under configuration management.

SECTION 4

4.0 QUALITY ASSURANCE PROVISIONS

The CCGIS quality assurance provisions are provided under each C4I system on which the CCGIS is applied and through the COE standards.

4.1 RESPONSIBILITY FOR QUALIFICATIONS

This paragraph is intentionally deleted.

4.2 SPECIAL TESTS AND EXAMINATIONS

This paragraph is intentionally deleted.

4.3 REQUIREMENTS CROSS REFERENCE

This paragraph is intentionally deleted.

SECTION 5

5.0 PREPARATION FOR DELIVERY

5.1 GENERAL

The CCGIS software and documentation shall be delivered per the guidance provided in the MCASS System/Segment Specification.

5.2 SPECIFIC REQUIREMENTS

This paragraph is intentionally deleted.

5.3 DETAILED PREPARATIONS

This paragraph is intentionally deleted.

SECTION 6

6.0 NOTES

6.1 INTENDED USE

The COE mission statement describes the intended use of the CCGIS.

6.1.1 Missions.

This paragraph is intentionally deleted.

6.1.2 Threat.

This paragraph is intentionally deleted.

6.2 STANDARD VERBS

A set of unambiguous transitive verbs has been identified and defined. This set of verbs is used in the presentation of the CCGIS requirements.

Calculate	apply mathematical operation to determine a data element's value.
Display	place information on a computer display device.
Edit	correcting, modifying, or adapting a data element in a controlled manner.
Export	the process of transferring data or software from one system to another system.
Instruct	tell the intended audience how to perform the designated function.
Maintain	preserving designated data elements through correction and updates.
Plot	produce a hardcopy on a computer plotter.
Print	producing hardcopy on a printer or printer/plotter.

6.3 ACRONYMS AND ABBREVIATIONS

ADRG	ARC Digitized Raster Graphics
ADRI	ARC Digitized Raster Imagery
ATCCS	Army Tactical Command and Control System
CASS	Common ATCCS Support Software
CGIS	Common Geographic Information System
CHS	Common Hardware/Software
COTS	Commercial Off-The-Shelf Software
GOTS	Government Off-The-Shelf Software
C2I	Command and Control and Intelligence
C4I	Command, Control, Communications, Computers, and Intelligence
DAFIF	Digital Air Field Information File
DBMS	Database Management System
DCW	Digital Chart of the World
DFAD	Digital Feature Analysis Data, Levels 1, 1C, 2, 3C
DMA	Defense Mapping Agency
DoD	Department of Defense
DTED	Digital Terrain Elevation Data, Levels 1, 2
DVOF	Digital Vertical Obstruction File
ECHUM	Electronic Chart Update Manual
GIS	Geographic Information System
ITD	Interim Terrain Data
MCASS	MTACCS Common Application Support Software
CCGIS	MTACCS Common Geographic Information System
MCHS	MTACCS Common Hardware Suite

MCSG	Marine Corps Style Guide
MGRS	Military Grid Reference System
MTACCS	Marine Tactical Command and Control System
PVOD	Probabilistic Vertical Obstruction Data
RDBMS	Relational Database Management System
SQL	Standard Query Language
TDA	Tactical Decision Aid
TDS	Tactical Decision System
TTD	Tactical Terrain Data
VOD	Vertical Obstruction Data
WDB II	World Data Bank II
WVS	World Vector Shoreline

6.4 GLOSSARY OF TERMS

The glossary contains primarily nouns. Action verbs are defined in Section 6.2.

Abnormal Termination: Unanticipated shutdown of system due to a software or equipment failure.

Accuracy: Accuracy refers to the amount of deviation from the actual or ground truth value. Map accuracy is normally measured in both horizontal accuracy (location on the ground) and vertical accuracy (height of ground).

Algorithms: Algorithm is the statement of the steps to be followed in the solution of a problem.

Ancillary Data: Ancillary data is auxiliary or supplementary data.

Area: Area is a level of spatial measurement referring to a two-dimensional defined space. A polygon on the earth as projected onto a horizontal plane is an example of an area.

Attribute: An attribute is a descriptive characteristic or quality of a feature.

Azimuth: Azimuth is the horizontal direction of a line measured clockwise from a reference plane, usually the meridian.

Bindings: Bindings are a rigid well-defined interface between two dissimilar components. In the context of this document, the dissimilar components are software modules.

Boolean Retrievals: Boolean retrievals are a search strategy for information retrieval based on the use of the logical operators AND, OR, and NOT to represent symbolic relationships.

Compression: Compression is a series of techniques used for the reduction of space, bandwidth, generating time, and the storage of data.

Contour: A contour is an imaginary line on the surface, all points of which are of the same value above or below a specified datum surface.

Coordinate Systems: A coordinate system is a particular kind of reference frame or system, such as plane rectangular coordinates or spherical coordinates, that use linear or angular quantities to designate the position of points with that particular reference frame or system.

Currency: Currency refers to how old the data is in relation to its rate of obsolescence.

Database: A database is a collection of information related by a common fact or purpose.

Database Management System: A database management system is software designed to access and structure a database.

Data Dictionary: A data dictionary is a repository of information about the definition, structure, and usage of data. It does not contain actual data.

Data Topology: Topology refers to the order or relationship of specific items of data to other items of data.

Jump: Jump is a map background operation which moves the map display center to another geographic location, normally off the current display area.

Digitising: Digitizing is the process of converting an analog image or map into a digital format usable by a computer.

Distributed Database: A distributed database is one with unique components in geographically dispersed locations linked through a telecommunication network.

Edge Matching: Edge matching is the comparison and graphic adjustment of features to obtain agreement along the edges of adjoining map sheets or images.

Elapse Time: Elapse time is the actual clock time taken to complete a command or operation as opposed to CPU time.

Encoding: Encoding is the process of converting data (text or spatial) to a form that is usable by a computer program.

Geographic Information System: A geographic information system is a system of computer hardware, software, and procedures to support the capture, management, manipulation, analysis, modeling, and display of spatially referenced data.

Grid: A grid is a network of uniformly spaced horizontal and perpendicular lines which enclose an area (a cell) with an associated value assigned.

Gridded Data: Data points typically represent the cartographic value of that point (e.g. an elevation post or a water depth). Examples: DTED, DEM (USGS), DBDB5, TERCOM.

Image Data: Pixels represent a measured intensity in a given spectral band such as gray scale, IR, or the RGB components of visible light. Examples: LANDSAT, SPOT.

Image Processing: Image processing encompasses the various operations that can be applied to image format data. These include, but are not limited to, image compression, image restoration, image enhancement, image rectification, preprocessing, quantization, spatial filtering, and other image pattern recognition techniques.

Import: Import is the process of bringing data or software from another system into a system.

Interactive: Interactive refers to a system allowing two-way communications between the computer and the user.

Layers: Layers refer to the various "overlays" of data, each of which normally deals with one thematic topic. Overlays are registered to each other by the common coordinate system of the database.

Map Boundaries: Map boundaries are lines that bound the body of the map, usually parallels and meridians.

Map Projection: Map projection is a systematic drawing of lines on a plane surface to represent the parallels of latitude and the meridians of longitude of the earth.

MCSG Graphic Data: Pixels represent a measured intensity from a paper map or chart. Scanned map can be captured as a RGB composite image. Example: ADRG.

Off-Line: Off-line is the transmission of information between a computer and a peripheral unit before or after, but not during, processing, in contrast to on-line processing.

On-Line: On-line is the transmission of information between a computer and a peripheral device such as a display while processing is occurring.

Pick: A pick is the selection of information for a given position on the computer monitor. The selection is made with the monitor cursor which is usually control via a mouse, track ball, or the keyboard arrow keys.

Point: A point is a level of spatial definition referring to an object that has no dimension.

Scale: Scale is the ratio or fraction between the distance on a map, chart, or photograph and the corresponding distance on the surface of the earth.

Map Scale: In general, scale refers to the ratio or fraction between distance on the map and the corresponding distance on the earth's surface.

Pan/Roam: Pan/roam is a map background operation which allows the user to move around the current displayed area and to adjacent areas which are not currently displayed.

Precision: Precision refers to the degree of refinement or level of detail of a value (normally measured in number of significant digits).

Three-Dimensional (3-D) Data: 3-D data is volumetric data representing measurements in three dimensions such as latitude-longitude-elevation.

Topological: Topological refers to such properties of geometric figures as adjacency that are not altered by distortion as long as the surface is not torn.

Topology: Topology is a branch of geometrical mathematics which is concerned with order, contiguity, and relative position, rather than actual linear dimensions.

Transformation: Transformation is the conversion of coordinates between alternative referencing systems.

User Interface: The user interface is the method by which the human operator communicates with the various system applications.

Utility: In the context of this document and computer software systems, a utility is a software program which can operate independent of the primary software program. The response time for utility software does not have to meet the primary software response time requirement.

Window: A window is a rectangular frame with a specified size and location on the screen of an interactive graphic system, and within which a rectangular portion, or window, of a map or other information can be displayed.

Zoom-In: Zoom-in is a CCGIS operation which decreases the size of the area displayed in order to see greater detail.

Zoom-Out: Zoom-out is a CCGIS operation which increases the size of the area displayed in order to see a larger area of view.

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